

# The American Biology Teacher

Vol. 11

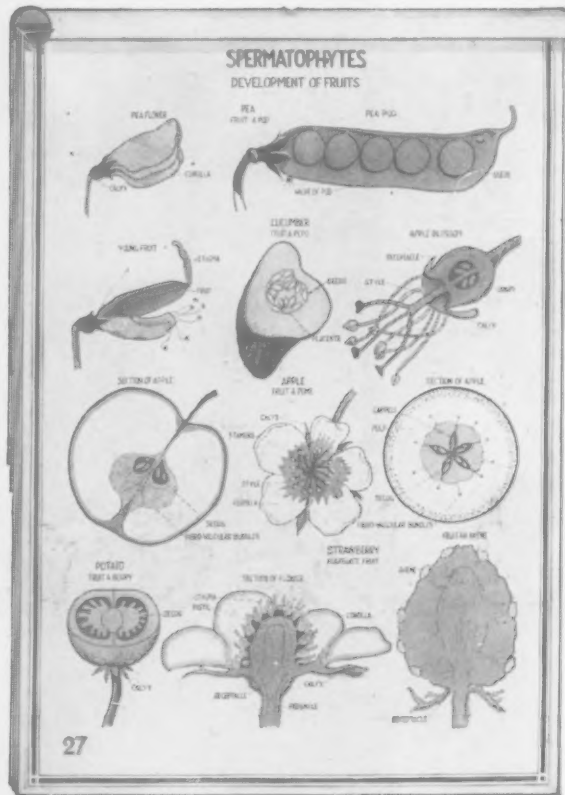
JANUARY, 1949

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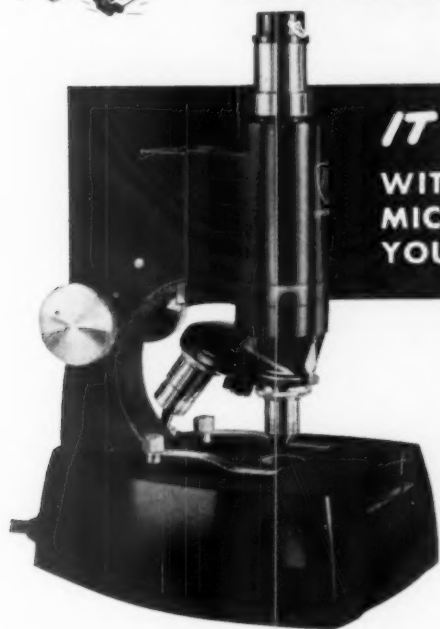
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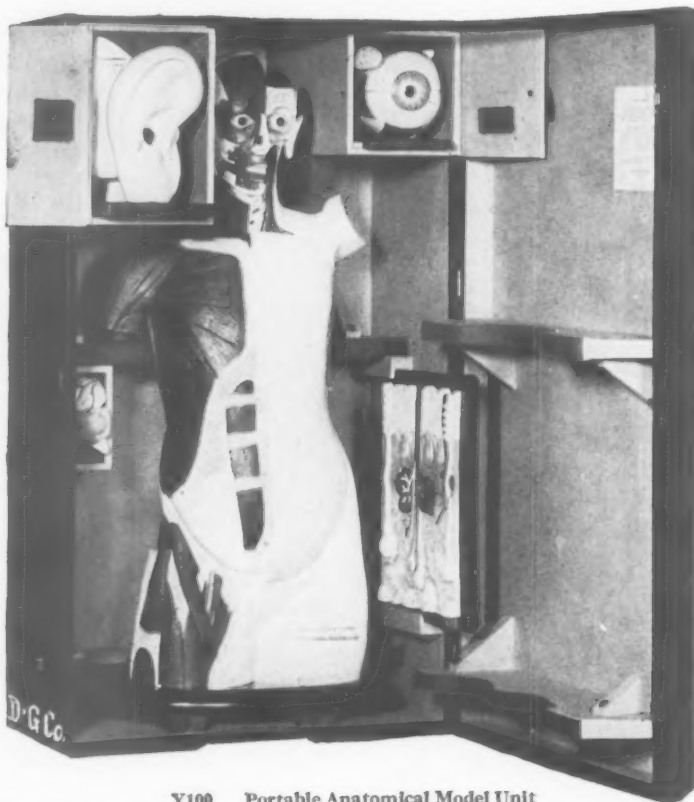
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# The American Biology Teacher

Vol. 11

JANUARY, 1949

No. 1

## The Effectiveness of Science Teaching

A FORUM BY THE AAS CO-OPERATIVE COMMITTEE ON  
THE TEACHING OF SCIENCE AND MATHEMATICS

*The Cooperative Committee on the Teaching of Science and Mathematics* of THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE was created in 1941 by representatives of several scientific societies to work on educational problems associated with science. The President's Scientific Research Board has asked this committee to aid in estimating the effectiveness of the training of scientists in the United States. The report of the committee is *Appendix II* of *Volume Four* of the *Report to the President of the Scientific Research Board*. It may be obtained from the Superintendent of Documents, Washington, D. C., for 35¢ a copy. The forum based on the report was held at the Chicago meeting of the AAAS in 1947. A recording of the forum is available; arrangements for its loan may be made with Dr. K. Lark-Horovitz, Department of Physics, Purdue University, Lafayette, Indiana. Dr. Horovitz is the chairman of the Co-operative Com-

mittee; former president Prevo L. Whitaker is the NABT representative on the Committee.

Because most biology teachers are interested in the teaching of other sciences, and many of them are actually teaching other sciences, the portions of the forum dealing with the physical sciences and mathematics, as well as the general report and the summary are presented here.

THE NEWLY ELECTED officers of *The National Association of Biology Teachers* appears on page 22 of this issue; other reports and papers of the national meeting will appear in the next two issues. The March issue will be devoted largely to papers given at the convention. Reports of business and news items will appear next month. To date, papers and abstracts are in hand from several of the individuals appearing on the program, including George M. Lyon, M.D., George B. Dowling, M.D., H. O. Burdick, Phyllis Cook Martin, and John E. Shoop. All of them deal with the subject of health, which was the central theme of the meetings. Some of the papers will be printed in full; of course space will not permit more than a digest or an abstract of most of them. An attempt will be made to select the portions printed so as to eliminate duplications and report the gist of the programs as nearly as possible.

## WHY THE REPORT ON THE EFFECTIVENESS OF SCIENTIFIC TEACHING WAS NEEDED

PHILIP H. POWERS, *Advisor on Scientific Personnel, Atomic Energy Commission.*

It is of course necessary for me to remark that I am speaking as an individual and not as a representative of any government agency, neither the White House where I was formerly employed, nor the Atomic Energy Commission where I am presently employed.

The question assigned to me almost answers itself. Scientific research requires scientists. This is always true, but today there is a serious shortage of this particular manpower resource, as there is of so many of our important resources. The shortage of highly trained scientists is probably the chief bottleneck to scientific progress today. The only place where this bottleneck can be broken is in our schools—grade schools, high schools, colleges and universities. No report on scientific research in the country could therefore be complete without considering "The Present Effectiveness of our Schools in the Training of Scientists."

We would like for scientists to come up with more answers on the common cold, on diseases of old age, on increasing the supply of food for a growing and hungry world and on many other problems. Radioisotopes give us a spectacular new tool for studying these problems. Heralding this new atomic age, we now have these isotopes in abundance, but we do not have the scientists with the training to use them.

This is but one bottleneck. There are many others. The question that needs to be answered is, "What is the prospect for getting the scientists needed?" How well are we doing in training a new group of young scientists to take over these jobs?

The report which the President asked his Assistant, Dr. Steelman, to prepare covers a broad assignment relating to scientific research in this country, both Federal and non-Federal. The size of the assignment and the variety of the material studied is at least suggested by the length of the report—999 pages. Of these, the particular appendix

that we are discussing tonight accounts for an even 100 pages.

The breadth of the assignment to the Assistant to the President can perhaps be made more clear by briefing a part of the Executive Order. The President asked him to serve as chairman of the President's Scientific Research Board and in this capacity to review all Federal research to determine (1) the fields of work, (2) the personnel required, (3) what part is done outside of government, and (4) the cost of all this research. He was also asked to review non-Federal research—its nature and scope, the personnel required, and its cost. In addition, he was specifically requested to review "the facilities for training new scientists."

On the basis of all this information, the Assistant to the President was asked to make recommendations for the Federal program—for improving its efficiency, planning and coordinating it, administering it and getting the necessary people.

Accompanying the Executive Order was a "Statement by the President," the last paragraph of which was, "I am concerned over the current shortage of scientific personnel and ask for a careful inquiry into this phase of the research program."

All of this boils down to a request by the President for a report on the overall status of American science, but with particular attention to the proper role of Federal research. The Board itself was a cabinet-level group, representing the agencies with major research and development programs. It was set up to assist and advise its Chairman.

To prepare such a report, it was clearly necessary to find out just how serious the shortage of scientists actually is, and to examine the underlying reasons for it. It was necessary to look closely at present trends to get some estimate of how quickly we may be able to get under way on some of the important scientific work that we cannot do at present.

It was necessary to find out how the scien-

tists that we have are being used. Are there, for example, too few scientists engaged in the training of more scientists or in basic research?

This is a very fundamental question, for it relates to short and long-range objectives of our society. We have always emphasized applied science in this country. In addition, we now emphasize military applications. We threw nearly everything we had into the war and in so doing neglected basic research and teaching. Are we still going too far in that direction? Are we still risking the quality of the future of science in order to make weapons and gadgets today?

Certainly we are taking some risks. We must do so to some extent. But how serious are the risks? Have we backed up enough from our war-time policy of depleting scientific manpower resources and our store of fundamental knowledge? Can we go right ahead and expand our Federal and industrially supported science, even if, in so doing, the expansion is at the expense of science teaching in the colleges and universities? In this competition for scientific personnel, are the incentives for working in government and industrial research laboratories too much greater than the incentives for teaching?

These are important questions. Let there be no mistake about that. The future strength and vigor of American science are at stake. The progress that we are going to make on the peaceful applications is at stake. If we go too far in emphasizing short-range objectives at the expense of long-range ones, that is, at

the expense of training top-notch scientists, then we risk the leadership which we may urgently want ten or twenty years from now.

These questions are as difficult as they are important. But one way to get some evidence on them is to check on the effectiveness with which we as a nation are presently achieving results (1) in applied research and development, (2) in basic research, and (3) in the training of new scientists. The staff of the President's Scientific Research Board sought answers to each of these questions. Tonight we are concerned with the third one on the training of scientists. Answers to this question were sought in several ways. Chief of these methods was, however, the request to the American Association for the Advancement of Science.

The best way to find out about the effectiveness of science teaching is to ask the scientists themselves. They were asked in several ways, but in this instance the President's Scientific Research Board turned to the American Association for the Advancement of Science as the most representative organization of scientists and asked them to give us the answer. Through the President of the Association, the request was passed on to its Cooperative Committee on the Teaching of Science and Mathematics. Their report was prepared and was then used by the President's Scientific Research Board in formulating some of the basic recommendations which appear in its report "Science and Public Policy."

## SCIENCE IN ELEMENTARY AND SECONDARY EDUCATION

MORRIS MEISTER, *Principal, High School of Science, New York City*

There have been several appraisals of science teaching in recent years—all of them good and most of them useful. The unique circumstance about the appraisal which concerns us this evening is that the President's Advisors were driven to make this evaluation by the dangerous lack of Manpower for Research. Evidently, Public Policy in an Atomic Age is tied to Science and Technology. Here, as in most things, it is men that count. And we do not have enough of them for the job that lies ahead. Because we were profligate

with science talent during the war, a generation of scientists was lost. Any effort to make good the shortage and improve the quantity and quality of competent men forces an examination into what science we are teaching, how we are teaching it, and how many are being taught.

This appraisal is notable in another respect. While ostensibly the President's Advisors are concerned with maintaining a full and steady flow of able scientists, they recognize the importance of a public that is literate in sci-

ence. Unless the later is true, the people will not support the plans and the recommendations of men of science. The Report to the President seeks a program of science education for all—a program which is as mindful of general education as it is of science education for the specialist.

But, what does the appraisal reveal about our present program? Instead of a twelve year science sequence, beginning in Grade One, relatively few children receive any organized science instruction until Grade Seven. In the earlier grades science teaching is, in many places, incidental. Sometimes it appears as part of the reading program and sometimes as the lesser adjunct in a social studies unit. Well trained elementary school teachers of science are few. Courses of study and textbooks show the kind of wide variation which is characteristic of an early stage of development. Equipment is either nonexistent or inadequate. Teaching procedures are not well designed. There is an almost total absence of concern about locating, stimulating and providing guidance for children with potential talent in science. The only encouraging sign is a widespread and heightened interest in this field.

What is the situation in secondary schools? First and foremost is an overcrowded curriculum, in which science is hardly represented to a degree in keeping with the needs of our times. All available data indicate that the percentage of high-school pupils enrolled in science courses has been declining. The typical pupil takes two science courses during four years of work; one in general science and one in biology. The contribution which physical science can make to his education is not provided beyond the elementary concepts treated in general science. A small number take the course in physics or chemistry at the eleventh or twelfth grade level; but the courses seem to be poorly designed for purposes of general education. Since such courses are offered to heterogeneous groups, the work often fails to serve the needs of the talented pupils in these groups. High schools rarely offer training in science beyond the initial courses in biology, chemistry or physics. Very little attention is paid to the experimental methods of science or to the de-

velopment of scientific habits and attitudes. Little use is made of the history of science with its adventure and dramatic action, so appealing to the interests of young people.

Another disturbing factor in the science teaching picture is the serious lack of competent teachers. It is worse in science than in other subjects. Good science teachers are being attracted by the larger salaries and easier working conditions in industry, in business and in government. There has been a decided decrease in men teachers. The teaching load of the science teacher is often discouragingly greater than that of other subjects. Frequently, the science teacher must teach, in addition, one and even two subjects not related to science. In too many instances, science teachers report inadequate teaching materials and special facilities required for good science teaching. Under conditions such as these, it is no wonder that high school science teaching is less than effective in realizing either the objective of general education or of stimulating and nurturing the potential scientist. At a time when the future of the Nation and of civilization itself depends upon better training in science, it is disquieting in extreme to find so little being done in secondary schools to identify and guide science-talented youth toward careers in science.

This, in brief is the essential indictment made by the Report to the President on science teaching in our schools. What, then, are the indicated solutions to the problem—the recommendations?

Basic to any improvement in the teaching of science for the purposes that are the concern of the President's Advisors, is a well-conceived machinery for the early identification and guidance of science-talented youth. Such machinery can operate informally in the elementary grades. A number of elementary schools have been experimenting with some very promising methods of stimulation and selection. In the ninth and tenth grades, special techniques for identifying special aptitudes can be employed. Here, one cannot over-emphasize the selective value of Science Clubs, Science Fairs and Science Congresses. These activities, when carefully planned, are the media in which science talent thrives. They are frequently the triggers which re-

lease dormant interests and abilities in young people. For many, they add the kind of purpose to school work which overcomes obstacles and contributes to sound growth and development.

In conjunction with these activities, schools can make better use of a steadily increasing variety of good aptitude tests in science, and of vocational interest inventories. The personal data thus obtained for each pupil can become part of the record of school progress which accompanies him from grade to grade. The program of guidance in the school can start with this record and include individual conferences, follow-up procedures, and the like. The guidance counselor and the science teacher are closely associated in the process of identifying science talent.

At least three general procedures are suggested by the Report, for dealing with the needs of science talented pupils. For the very small high school, only the generalized science courses are feasible; but the teacher can develop special projects, reports and teacher assistance for those able and interested in science. Science Club activities are especially valuable in this connection. Sometimes, correspondence courses in certain science fields have served a good purpose.

In the larger schools, the pupils gifted in science can be scheduled for "Major-work" or "Honors" classes under competent science teachers. In other subjects, they join with classmates from varied curricula.

A third procedure, possible in the larger school systems, is to organize one or more specialized high schools. Any city large enough to support five high schools can profitably designate one of them as a High School of Science. Under this arrangement, an organized program of selection can be carried out. Excellent results have been obtained in practice by basing the selection of students upon a written test, a study of previous school record, the recommendations of the lower school authorities and, in some instances, a personal interview. The written test consists of carefully assembled CAVD material, refined over a period of years, so that the test becomes a valid and reliable instrument for selecting ninth graders who do unusually well with a curriculum oriented in

science and mathematics.

In the six annual Westinghouse Talent Searches, students from two such High Schools of Science have repeatedly been selected for honors, in numbers out of proportion to their school populations. One of these schools, with a register of about 2,000, has had from one to four "winners" in each of the six annual competitions. The curriculum of a High School of Science includes 4 to 5 years of science study and laboratory work, 3 to 4 years of mathematics, 4 years of English, 4 years of social studies, 3 years of one foreign language, together with the usual requirements in art, music and health education. Such a curriculum does not lack in elements of general education and is quite in line with college entrance requirements.

A second recommendation of the Report stresses the importance of a carefully planned program of science instruction for all pupils. This program must articulate the work in high school with that in the elementary school and must aim at the steady development understanding of important science concepts. In essence, this recommendation will achieve a higher degree of scientific literacy among the citizens of a democracy. The recommendation also carries with it the implication that three years of science be required of all high school students. A strong plea is made for a year of physical science (rather than physics or chemistry) to follow the courses in general science and biology. For the science-talented students, four to five years of science are recommended. Here, courses in biology, physics and chemistry can serve a real need. Often such students can profit from an advanced course in physics, chemistry, or biology.

Another recommendation stresses the importance of adequate laboratory facilities, equipment and supplies. The Report recognizes the unique educational contributions of teacher and pupil demonstrations; but emphasizes the importance of individual laboratory experimentation. For the science talented pupil, the laboratory is the place where he learns "to put questions to nature" and where he can obtain answers to problems by the methods of science. Such laboratory work shifts the focus of activity from passive ob-

servation to active participation; it develops skill in coordination and manipulation. Individual laboratory work is a golden opportunity for developing resourcefulness in the use of physical materials and instruments of measurement.

Recognizing the shortage of highly competent science teachers, the Report urges an improved system of in-service training, teacher workshops, counselling service and supervision. To quote from Raleigh Schorling's Bill of Rights for Teachers, "Every teacher has the right to an adequate amount of helpful and constructive supervision". To this "Right" can well be added the Right to teach classes that are not too large, the Right to have time in school for planning, the Right to a 45-hour week, the Right to have good materials and enough of them, the Right to work in a room that can be made pleasant and appropriate to the tasks to be learned, and the Right to adequate compensation.

The capstone recommendation of the Report concerns itself with a National Commission on the Teaching of Science and Mathematics. This Commission should be

given the wherewithal for conducting certain essential studies, so that answers to very vexing problems can be obtained. A complete appraisal of science and mathematics teaching in secondary schools should be made. More carefully planned teaching materials, for both pupils and teachers, must be developed. Studies should be made of various curricular and administrative arrangements employed in small and large communities to meet the needs of talented youth. Guidance procedures for identifying science talent should be further developed. What are the most effective ways to use demonstrations, laboratory work, projects, shopwork, field excursions, and audio-visual aids? What are the important science concepts basic to effective citizenship in a democracy, in this atomic age? What is the most effective age and grade placement of these concepts in the curriculum?

These are fundamental questions. They can be answered only through intensive investigation and study. The present crisis in science teaching can be relieved if means are provided for conducting such investigations and studies.

## THE EFFECTIVENESS OF OUR SCHOOLS IN THE TEACHING OF THE BIOLOGICAL SCIENCES

L. V. DOMM, *Whitman Laboratory of Experimental Zoology, The University of Chicago*  
GLENN W. BLAYDES, *Department of Botany, The Ohio State University*

The Biological sciences bear a tremendous responsibility in solving numerous crises which human society is now facing. In biological education we must contrive more adequate training for our people in order to solve many of these impending problems.

Of all the land areas in the world only about 11 per cent or 4,000,000,000 acres are suitable for food and fiber production. There are about 2,000,000,000 human beings living in the world today. They must get their foods and fibers from this area. This means that there are available to each person only two acres,<sup>2</sup> or about twelve average city lots upon which his foods and fibers may be produced. In Ohio,<sup>3</sup> records for the average annual yields of the cereal crops extend over a period of almost a century. The average annual yields of these crops today are about

what they were 100 years ago. During this period improvements have been made in crop plant varieties, methods of tillage, use of fertilizer, crop rotations, and the invention of agricultural machines, which should have increased yields, according to conservative estimates, from 40 to 60 per cent. These advances, as great as they may be, have not

<sup>2</sup> Milton S. Eisenhower, "Two acres for your life," *Collier's* 119 (19): 80, 1947. Variation in such estimates occur from about 8 acres to each person, as given by Raymond Pearl, "War and Overpopulation," *Current Hist.* 43: 589-594, 1936, to about 1 acre by Frank A. Pearson, and Don Paarlberg, "Starvation Truths, Half-Truths, Untruths," N. Y. State College of Agriculture, Cornell University, Ithaca, N. Y. 1946.

<sup>3</sup> R. M. Salter, R. D. Lewis, and J. A. Slipper, "Our Heritage—the Soil," Bulletin 175, Agricultural Extension Service, The Ohio State University.

been more than sufficient to maintain the yields of a century ago. The destructive forces of accelerated erosion and depletion of soil minerals and humus content are equaling the advances that man has made. These destructive forces are winning slowly, but with a dreadful certainty. Not only are your two acres and mine producing less and less, but with an increase in population we must divide some of our food with others. These facts are well known, yet when a study was made in 1942 of the biology courses in the secondary schools of the United States,<sup>4</sup> only 11 per cent indicated that some emphasis was placed upon the subject of conservation! Many of the more important facts and principles of biology have direct application to the problems of conservation. In fact our only hope that the yields of food may be maintained and increased is dependent upon the spread of these facts and principles and their applications to the soil and the organisms growing on it.

In the same survey only 13 out of 1,086 replies claimed some attention given to the process of photosynthesis. This process is surely one of the most fundamental in all biology. It is a process occurring in green plants by which light energy is converted into chemical or stored energy. Sugars are made and contain this energy. This energy runs the biological world and most of the industries of man. Also, sugars become the chief "building blocks" from which all other foods and biological substances are made. In addition to the sugar made by this process, oxygen is released. This is the fundamental source of oxygen which maintains a fairly constant concentration in the atmosphere about us. It is being steadily used by most organisms in the process of respiration. An average high school boy or girl, with a few potted green plants and a balanced aquarium, can demonstrate effectively the process of

photosynthesis. By a few careful observations it is readily determined that the environment of the plant is important in the process—that light, carbon dioxide and water are necessary, any one of which may limit the process—that the process does not occur in non-green tissues and hence the importance of the green pigment chlorophyll. Here we have all the elements of a good experiment concerning a biological process, factors of the environment, conditions within the organism, sugar that is made and the oxygen released in the reaction. With a minimum of directions from the instructor, the student is able through his own observations to discover the fundamentals of this important biological process. He does not have to get his answers from the teacher, or a textbook—he discovers them himself! When confronted with the question of why grass is not growing in a densely shaded area under a tree just outside the laboratory window he is not long in coming up with the answer—that any plant starting to grow there dies of starvation since it cannot make sugar in the dense shade. We have here a demonstration of the scientific method of approach and a cause and effect type of explanation. The teacher then looks up at the electric lights in the laboratory, he moves over to the light switch, snaps it off and on again. He asks the student of photosynthesis to trace the origin of the electric energy observed in the electric light. Soon, he is able to trace it to the dynamo, steam turns the dynamo and the energy of steam comes from the burning coal under the boilers, the coal is plant material which lived some 300,000,000 years ago, storing energy from sunlight which we can command today by turning a switch! About 89 per cent of the biology teachers in high school are missing an opportunity to teach more effectively when they fail to include photosynthesis in their biology courses.

Another relatively unpopular subject and one of a controversial nature, which was studied in the survey of biology courses<sup>5</sup> of

<sup>4</sup> Oscar Riddle, F. L. Fitzpatrick, H. B. Glass, B. C. Gruenberg, D. F. Miller and E. W. Sinnott. The Teaching of Biology in Secondary Schools of the United States: The Committee on the Teaching of Biology of the Union of American Biological Societies. 1942. This report was published in the American Biology Teacher, Feb. 1941 to Mar. 1942.

<sup>5</sup> Riddle *et al*, 1942.

some five years ago, is that of evolution. This principle permeates the whole of biological sciences. For the well trained biologist it is fundamental, it is inescapable! Yet less than 50 per cent of the high schools of the United States include this subject in their biology teaching. If anything, it is an educational liberator—a liberator from dogma passed down from the dark ages, by those with absolute ignorance of this biological phenomenon, and forced through fear upon more than 50 per cent of our high school population. About 90 per cent of those in high school will never have a chance at another point of view. A good observer does not have to look far until he finds cases of heritable changes taking place in plants and animals including man. All that is meant by evolution is that heritable changes may occur. Mutations, hybridization and hybrid segregations are bases by which all of our domesticated plant and animal varieties have made their appearance. Consider all of the varieties of wheat, potatoes, corn, tomatoes, dahlia, gladiolus, iris, apples, peaches, cherries, swine, cattle, dogs, cats, chickens, rabbits, etc., and you have an astounding array of evolutionary evidence existing about us. Practically 100 per cent of man's present day food and fiber supply comes from domesticated plants and animals. In addition, most of the recognized successful medical and surgical methods were developed through the use of laboratory animals, such as mice, rats, rabbits, dogs, guinea pigs, pigeons, chickens, frogs, and fish. As most people will admit, many of the results attained in medicine and surgery are very successful! What is the biological inference that may be drawn from these examples? We leave that to you. If a fundamentalist boycotts foods and fibers from domesticated plants and animals, and medical and surgical methods because the process of evolution is involved, it is not long until he is in serious difficulty. Actually he declares no boycott but simply ignores the problem.

In the country-wide survey<sup>6</sup> of 1942, another relatively unpopular subject, as far

<sup>6</sup> Riddle *et al.*, 1942.

as being included in biological courses is concerned, is that of sex education. Out of 2,900 replies only about one third indicated that the topic was taught. A similar survey<sup>7</sup> conducted in a rural county of Pennsylvania in 1946 indicated that 40 per cent of the schools had no sex instruction. When taught, ordinarily it is included in biology courses; however it may be presented either as straight biology or in hygiene, physiology, botany and in physical education. All the processes and structures of the human body are openly discussed without restraint, with the exception of those concerning sex. Adolescent boys and girls are curious about their bodies and how they work. Ordinarily they are left to their own devices for getting the information on the streets and in disreputable places. Our schools should be a source of dependable information concerning this fundamental phase of human biology. The school should aid boys and girls in developing a wholesome attitude toward sex and toward each other. Sex is the basis for numerous psychological disturbances in many persons. Sex maladjustment is responsible for many broken homes. Juvenile delinquency is on the increase.<sup>8</sup> A large percentage of these cases are sexual delinquents. About 20 per cent of those arrested for sex crimes in 1946 were persons under eighteen years of age. This is a serious charge against the moral and social education of the children of the United States. Our schools make every possible effort to better this situation through sex education. At present the schools are handicapped in that many biology teachers are not adequately trained in the subject, and most biology textbooks contain nothing on human reproduction, or at best a very inadequate amount.<sup>9</sup> However, something vastly more tangible can be done and is being done in a few places. As one example, a new course which has a unit on

<sup>7</sup> Thomas H. Knepp, "Biology Teaching in the High Schools of Monroe County, Pennsylvania." *Proc. Pa. Acad. Sci.* 20: 53-56. 1946.

<sup>8</sup> Uniform Crime Reports for the U. S. and its Possessions. Issued by the F. B. I., U. S. Dept. of Justice, Washington, D. C. Semi-annual Bul. 1946.

<sup>9</sup> Thomas H. Knepp, "Sex Instruction in the High School." *Tutor News* 25: 57-62. 1947.

sex education, is being presented in the Arsenal Technical School of Indianapolis.<sup>10</sup> The principal, Mr. Hanson H. Anderson, says, "The entire course entitled 'Family Relations', which contains a unit on sex education, has proved popular and is well received by parents and the public. There has been absolutely no criticism on the part of the members of the class taught or from the parents. The only criticism which I have received has been from a few members of my own faculty that the one unit of work was too frank and open. On the contrary, parents have told me that the school is accomplishing something which they know not how to do, but which they are willing for their boys and girls to know. A large part of the success of such a delicate subject hinges on the personality of the instructor and his method of approach. My opinion is that it is time that secondary schools were taking hold of this part of the education of adolescents."

In conclusion, it would seem from the few examples chosen from different phases of biology, that many teachers fail to have clear-cut objectives in their courses largely as a result of inadequate training. In a good many instances there is a lack of understanding on the part of the teacher of many biological phenomena and how they are related to present day human problems. Too often they fail to appreciate the value of using living organisms in the classroom and

<sup>10</sup> Facts stated in a personal communication.

that of extending the laboratory to the field of the local community. Students should be given adequate opportunity to make observations, to experiment, then to use the facts observed in solving specific problems, or in the derivation of principles. The development of the scientific attitude and the scientific method of approach should be important goals in teaching the biological sciences. These faults are not directly those of the teachers. Rather, the responsibility lies with the system which allows them to become teachers of the subject and with the college or university in which they received their training. It is imperative that the institutions training biology teachers give more serious attention to this problem. Too often it is assumed that a student who has taken the general course and one or two advanced courses in the subject, has had sufficient background of facts and principles so that he can relay this subject successfully to a high school class. The foregoing illustrations in this discussion do not bear out this point. These college courses too often fail to transfer breadth of understanding or comprehension even within the field of biology. Our colleges and universities should offer methods courses, taught by thoroughly trained biologists, and designed specifically for training prospective biology teachers, enabling them to appreciate the objectives of the field of biology more clearly in relation to the great problems of the biological world.

## THE EFFECTIVENESS OF THE TEACHING OF THE PHYSICAL SCIENCES

LLOYD W. TAYLOR, *Professor of Physics, Oberlin College, Oberlin, Ohio*

The service which the Cooperative Committee was asked to provide to the President's Scientific Research Board was quite in line with the committee's previous activity. One of the earlier reports included a passage with which I may appropriately begin my present remarks.

"The end of World War II has confronted American education with two highly disturbing facts. The first fact is that the survival of modern civilization depends upon under-

standing and control of scientific techniques whose power for good and evil dazes human imagination. The second fact is that our teachers and our equipment for teaching this understanding and control are woefully inadequate.

"Science teaching, particularly at the high school level where the ordinary citizen finishes his formal education, is not ready in America for the responsibility which it must nevertheless assume. Nor is education ready in other subject areas for its obligations in an atomic age. The time is short. The task is nothing less than to lift a whole generation of Ameri-

can citizens to a level of knowledge and human goodness which has hitherto been attained by only a small fraction of our people."

The magnitude of this objective, coupled as it is with the virtual certainty of catastrophe if it is not attained, is positively frightening. And it is not made any less so by the question which immediately occurs: "Why limit the program to 'a whole generation of American citizens'?" Indeed if we do so limit it shall we not jeopardize the whole undertaking? If two world wars in one generation have taught us anything it is that one powerful nation, if unscrupulous, anti-social and committed to international brigandage, can frustrate the peaceful intentions of all the rest of the world. The ideal then, however unattainable it may seem to be, would be to include all the major powers in such an educational program along with as many of the smaller nations as could be persuaded to go along.

Stated in this way the problem appears almost hopeless. Possibly it is, but let us not be too precipitate about reaching such a conclusion. Perhaps there is some encouragement in the fact that it seems reasonably possible to get general recognition of the existence of such a problem. Certainly the irreducible minimum condition for dealing with it will be our own recognition of it and our courageous attack on it.

If we classify mathematics with the physical sciences, as was done in the President's report, we come face to face with the fact that the teaching of mathematics in primary and secondary schools has been so inept that almost the entire population is negatively conditioned to arithmetic and still more so to mathematics in general.

Even in the experimental sciences our record as teachers has not been all that we sometimes like to think. So poor has been our scientific exposition that the proverbial man on the street expects scientific miracles with almost as much indiscriminating confidence as that with which savages expect miracles of their medicine men. One can even detect traces of affected pride in such expressions as "Of course I could never expect to understand that."

The twentieth century variety of lack of scientific comprehension, rooted in a defensive lack of curiosity, is so widespread as to be very disquieting. All the sciences, and particularly the physical sciences, are increasingly dependent on mathematics. And yet the typical layman's mental processes become paralyzed the minute a mathematical symbol appears on the scene. This bodes ill indeed for the general comprehension of science that must constitute the principal reservoir of support to which scientific progress of the future must look in a democracy.

Though the President's report did not concern itself primarily with the problem of stimulating a general comprehension of the nature of science among laymen, that problem was so pervasive that it cropped up irrepressibly at many points in the report. It turned out, indeed, that this was one quarter in which we teachers of science have met all but complete defeat up to the present. We knew before the war that in training scientists (as distinct from teaching science to the layman) we were doing a good job. The war merely showed that in that restricted field we were doing even better than we had thought.

But on the longer range undertaking of insuring the future of science by a broad policy of science in general education we have made very little headway. The corresponding professional inertia among artists was overcome long ago and art education for the layman is a major activity. In the field of music it is only within the last generation or so that the corresponding development has occurred. The dividends were immediate and overwhelming, as anyone in touch with college or community musical organizations knows.

A similar awakening among teachers of the physical sciences is long overdue. The ground is being broken at the secondary level by science clubs and science talent searches such as that of Westinghouse. But science in elementary schools lags, and the general courses in the various sciences at the college level have not begun to catch the spirit of universal education. This is primarily because college and university teachers are pri-

marily subject matter specialists and only secondarily educators. This condition will continue until there is a radical change in the type of graduate training received by prospective college teachers.

In a democratic system, such problems as those now facing science education cannot be dealt with by administrative fiat. Only an informed and aroused public can provide the necessary support. The required information must reach the public primarily through professional scientists. The day when men of science can safely confine their activities to narrowly professional pursuits has passed. Having long tried the experiment of leaving the exposition of elementary science to ill-trained teachers and to the Sunday supplements, we find that the attempt has in large measure failed, and this in spite of some truly remarkable work on the part of some of the outstanding science editors. But unless men of science themselves do far more of this kind of work than they have in the past, the western democracies will presently find themselves at the mercy of those accustomed to solve such problems by dictatorial procedure as the price of survival!

There is one measure that many universities, especially the larger research centers, can take that might speed up considerably both the volume of research and rate of production of trained scientists. There is scarcely a research center which does not have an accumulation of temporarily or permanently discarded apparatus, some of which could be used to advantage by smaller institutions. A system of apparatus loans, at first by direct negotiation but ultimately through some central clearing agency established for the purpose, would be highly advantageous. Indeed it should be one of the measures to be undertaken in the interest of good public relations of science.

Perhaps such a loan program could be made even more effective by sending along with the apparatus some Masters-degree candidates. Our big-name universities are swamped. It would be to the interest of everybody concerned if they could concentrate on upper-level candidates for the doc-

torate in science, enlisting well qualified colleges and smaller universities (there are many such) in the lower-level graduate work under their supervision. Many problems would arise in the administration of any such plan, but they would be as nothing compared with the problems that will rise out of failure to improve every opportunity for the vigorous prosecution of science education on every front.

Needless to say, every inducement should be offered to promising young scientists to prepare themselves adequately for effective careers. The President's report recommends a series of scholarships and fellowships far beyond anything in existence at present outside of the educational features of the G. I. Bill. For the details of these and other proposals to the same end you should consult the original report.

In conclusion, society now faces a crisis by reason of a vast increase in the demand for scientific services at the higher levels, simultaneously with a sharp diminution of the supply of trained scientists. This can be attributed in general to the war itself, but may be more specifically identified as primarily a consequence of a suicidal policy of induction procedure. That policy could well have cost us the scientific leadership of the world, which in these days means the political and economic leadership. Even as it is, the United States has been grievously wounded. To heal those wounds expeditiously will require all the resources that we can summon, public and private. Under democratic procedure only an informed and aroused electorate can authorize the necessary measures. Whether the required education of the public can be effected in time to enable it to preserve its own cultural integrity may be a question. Earlier cultures have disintegrated under less threatening conditions than now exist. Our only chance lies in prompt, far-sighted, vigorous and sustained effort on the part of those who are aware of the crisis and are in a position to guide our natural and human resources to avert it. The time is short and the chance is long. But we have no choice.

## MATHEMATICS—GRADES ONE TO TWELVE

RALEIGH SCHORLING, *School of Education, University of Michigan*

There is nothing wrong with the teaching of mathematics in grades 1 to 12 that a gifted teacher in every classroom could not correct. How to get a competent and zealous teacher in every classroom is, and always has been, the nation's number one educational problem.

The ceiling as regards what teachers can achieve under present conditions is low. But we must do what we can. To that end, it is important that we see clearly our main problem. The recent report<sup>1</sup> of the Cooperative Committee on the Teaching of Science and Mathematics lists a considerable number of limitations or weaknesses in our teaching of mathematics in grades 1 to 12. All of them, it seems, can be classified under three major problems:

- (1) the meaningful teaching of symbols, concepts, and principles,
- (2) the identification of the specific mathematics that needs to be included in general education, and
- (3) the proper culture of youth who have special talent in mathematics.

## I. AN EMPHASIS ON MEANINGS

A fundamental weakness in the teaching of arithmetic is that many pupils do not understand what they are doing. This is often true even when they understand the mechanics of the solution and get the right answers. Then too, pupils turn in fantastic answers without even realizing that their contents are absurd. *There isn't sufficient emphasis on meanings.* Pupils may be required to memorize tables involving pints, quarts, and gallons, or inches, feet, and yards, without meaningful or sufficient experience with the actual objects used in measuring. The tendency to force symbolism and drill upon children too early is very pronounced. The pedagogical principle that understanding of words, symbols, and principles stems from

<sup>1</sup> *Manpower for Research*, Volume Four of *Science and Public Policy*.

<sup>2</sup> *A Report to the President, by the President's Scientific Research Board*. Washington: Government Printing Office, 1947.

experience should be applied in the teaching of most of the concepts commonly included in arithmetic courses.

In formal instruction we often put the cart before the horse. Here is a common routine: (a) A school system administers a standardized arithmetic test. (b) It discovers that the control of the fundamentals in arithmetic is shockingly low. (c) It goes into an all-out program of drill workbooks. In all probability the pupils have had plenty of drill of the wrong kind and are now given larger doses of a medicine that heretofore has not taken effect.

## II. MATHEMATICS IN GENERAL EDUCATION

In recent years, universities and colleges have given a good deal of attention to general education. The high school, since the turn of the century, has had the dual responsibility of providing (a) rigorous training for leadership in science, mathematics, and other learned fields, and (b) good general education for better living and for use in the common affairs of life. It may be that the college people are not talking about the same thing as the high school people when they discuss general mathematics. It may be that we need two definitions for general education—one as an essential for citizenship, and the other appropriate for the well-educated person. Be that as it may, we will not get anywhere in our high school program of general education until somebody defines what it is in a way that is commonly acceptable. Here it is gratifying to know that a first step has been taken in the Second Report of the Commission on Post-War Plans of the National Council of Teachers of Mathematics.<sup>2</sup> The report identifies 29 specific concepts and principles in mathematics that are considered essential in the education of all citizens.

## III. THE CULTURE OF TALENT

A sound educational program for youths with special talent in mathematics would no doubt be equally desirable for students

<sup>2</sup> "The Second Report of the Commission on Post-War Plans," *The Mathematics Teacher*, May, 1944, pp. 226-32.

gifted in other fields, such as art, music, invention, statesmanship, and creative writing. Under the present conditions in our schools, it is highly probable that many youngsters with special talents are lost, or at any rate that they do not develop as well as they should. We cannot be confident that the typical teacher of the early grades with little or no training in mathematics and science can spot a youngster with talent in these areas or that she would be able to design appropriate experiences that would fan the spark of genius. Then, too, many of the senior high school courses do not now provide sufficient challenge and certainly not enough practice in the scientific method for talented youth.

A good program for gifted youth, whether it be in mathematics, art, or any other field, would seem to involve (1) early identification, (2) reliable guidance, and (3) an appropriate curriculum for the individual student.

**1. Early Identification.** There is good reason to believe that the beginning of the ninth school year is the time for differentiation of courses and classification of students. The future scientist is almost certain, by that time, to want more organization, more rigor, and more continuity, than can be or should be provided in the general courses. In the ninth grade we should operate a double track—at least in mathematics.

In sectioning students, schools should abandon the undesirable practice of attempting to get homogeneous groups by classifying pupils on the basis of intelligence tests alone, for that policy inevitably stigmatizes the general mathematics courses. Other things that should be taken into account are reading, computation, and general achievement in the earlier grades. Then too, some schools seem to find it helpful to use algebra aptitude tests.<sup>3</sup> The best single criterion obviously, for selecting a pupil for the algebra class, is the desire and the ability to do algebra of a high order of excellence.

**2. Reliable Guidance.** High school teachers in general do not provide their students

<sup>3</sup> Herschel E. Grime, "Aptitude and Ability in Elementary Algebra," *School Science and Mathematics*, December, 1947, pp. 781-784.

with reliable information about the science and mathematics needed on jobs and in professional careers, for two reasons: (a) the teachers lack knowledge of the applications to science and mathematics made in engineering, agriculture, mining, medicine, and the like, and (b) they do not have the necessary guidance materials.

The first guidance material geared to a high school subject was published in the November, 1947 issue of *The Mathematics Teacher*. The purpose is to describe for high school pupils some of the occupations in which mathematics is important. The student learns about the amount and kind of mathematics that is used and the school level at which it should be taken. Reprints should prove very useful to guidance personnel, in classifying students at the ninth-grade level. Here teachers of mathematics can find information that they can give to pupils and parents in a long time program of guidance prior to the ninth grade.

**3. An Appropriate Curriculum.** The teaching profession has not shown great resourcefulness or utilized much imagination in the design of curricula appropriate to the nurture of genius. Presumably this is a difficult task for the curriculum builder in any field. For thirty years at least, pedagogical journals have given much space to the problem of adjusting to individual differences. In a very real sense a good high school has to provide a curriculum for each individual child. This, of course, does not imply that youth of talent will not move in classes. In the small schools they would no doubt be in non-homogeneous groups. Nevertheless, special provision should be made—if not by especially designed courses, at least by appropriate assignments, by challenging projects, and by bits of research that take the pupil out of competition with his less able fellow students. Such glimpses at the achievements of creative workers in his field of special interest and at the steep road ahead of him will keep him humble and fire his imagination. Probably the crux of the matter is the competent and inspiring teacher with a small class. At any rate, the unusual showing made by certain small colleges in

the development of outstanding scientists needs to be explained.

To what extent especially designed courses for talented youth would be effective, no one can say. The education of gifted children in separate groups is one of the relatively new programs in public education. It could turn out that a comprehensive investigation of the problem might show that the finest algebra and geometry courses of the traditional type are not the best mathematics courses that can be provided for the future scientist. The fact is that the typical first-year algebra course does not nurture scientific aptitudes and certainly is not realistic as regards problem material, to say nothing of an emphasis on the method of science. As long ago as 1902, closer correlation of mathematics and science was suggested by Eliakim H. Moore, when he asked his now famous question: "Would it be possible to organize the algebra, geometry and physics of the secondary school into a thoroughly coherent four years' course, comparable in strength and closeness of structure with the four years' course in Latin?"<sup>4</sup> As the outcome of Moore's suggestion there have been several extensive efforts to define the kind of mathematics program that he had in mind. Industries such as the Ford Motor Company and the Chrysler Corporation have designed and sponsored mathematical units in textbooks that do not follow the pattern of the tra-

<sup>4</sup>Quoted from an address made in 1902 by Professor Eliakim H. Moore. *Science N. S.*, March 13, 1903, pp. 401-16.

### SCIENCE TEACHING TODAY\*

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You have heard why a survey of the present status of science teaching was necessary. The number of scientists in the nation is small; only around 137,000 can be classified as productive scientists. The training of these scientists on an advanced level is limited to a small fraction of our colleges and universities; some 50 institutions are re-country. The present influx of veterans into

\* A Summary of the report of the Cooperative Committee on "The Effectiveness of Science Teaching."

ditional courses in mathematics. Finally, we may note that much of the training program in the schools of the armed forces, designed for students who had to learn something in a hurry, took the form of a correlation of mathematics, industrial arts, and simple physics. Therefore, the Cooperative Committee recommends that a scientific study be undertaken to explore the mathematical needs of students with scientific aptitudes and to design a new course of study in mathematics in the event that one is indicated.

It may of course turn out that the traditional courses are the best fit. In fact, there was not much criticism of them by persons responsible for the training programs in the armed forces. On the other hand we may discover that we must go much further than Moore's proposal and relate mathematics instruction to all the science taught in high schools. The time has come to find out.

There is no existing machinery and there are no funds available for the type of study proposed here. Our professional organizations are not in a position to undertake the thorough investigations that are here suggested. It is to be hoped that the National Science Foundation, if and when created, will make this investigation one of its first projects, for certainly neither science nor mathematics teachers have ever made a serious effort to meet the challenge of the vision expressed by Moore nearly a half century ago.

sponsible for 95% of all the Ph.D's in this our colleges tends to crowd many into so-called name institutions without full use of staff and facilities in smaller institutions. The increasing opportunities in industrial and government research laboratories has taken its toll of college and university faculties and the increasing student-teacher rate threatens everywhere seriously the efficiency of teaching, particularly of the natural sciences. Therefore, the problems of science

teaching presented today show that we have to consider first of all the recruiting and training of teachers at all levels. To the estimates mentioned today we may add that the President's Commission for higher education foresees that between 1950 and 1960 one million new teachers will have to be recruited and trained.\*\* Where are the science teachers going to come from if only 1% of our college population is in practice teaching, and if only .13% are practice teaching in science and mathematics? Of all the people planning to go to college, less than 1% want to become college and university teachers, and all this with ever-increasing enrollment in the schools and universities; and obviously without teachers, there will be no adequate preparation of students and no scientists to take up the work of the older generation.

But to remedy this situation and to bring science to the citizens, we must start early; the deep curiosity of the child might be kept stimulated throughout the course of education, and for this purpose we have to consider the problem from the elementary, through the secondary, to the advanced type of education.

The science curriculum in the schools has to be considered as an integrated program from the 1-12 grade. Every effort must be made to introduce systematically the concepts and ideas of science which the *average* citizen needs to understand. On the other hand, it is essential to select and identify at an early age the specially gifted, and use all guidance and selection techniques to ascertain that these students will have the full opportunity to develop their talents while they are still in the schools.

The most difficult part of the science programs in the schools is usually the integration with mathematical concepts. These mathematical concepts introduced in the elementary schools in the form of arithmetic and elementary geometry are usually divorced from applications in the work actually being done at the same time in the sciences. But

\*\* "Higher Education for American Democracy." Volume I "Establishing the Goals," A Report of the President's Commission on Higher Education, December, 1947, p. 77.

it is essential that we provide a background in the elementary techniques of mathematics both for the student, who will go on to college, as well as for the citizen who will receive the last formal education in high school. For this purpose, the double track method is recommended, which means courses in general mathematics, which should prepare the citizen with a better understanding of quantitative formulations, and on the other hand the elements of algebra and geometry have to be taught to prepare the students for college.

Unfortunately, science is still not a general prerequisite for college entrance and it is possible for a student to go through high school and college and remain scientifically illiterate, at least in so far as the physical sciences are concerned. This is true in spite of the fact that a great many of the applications of science and their implications are now discussed widely and effectively by the public press. But in academic education, up-to-date information which the student demands is usually lacking because we do not have enough source material from which the teacher can draw with full understanding of the scientific and cultural background.

This becomes painfully clear in the physical sciences. It is shocking to hear that in this age of atomic energy, only about 7 per cent of our total high school population are exposed to physics or chemistry. It is still more shocking to realize that a student can go through college, and even become a teacher of science, with not more than possibly one science course in the field in which he wants to specialize, and hardly any understanding of the physical basis of science.

The physical sciences present a unique problem to the teacher because they require that there is a constant check of theoretical and speculative predictions by experiment and that the planned experiment must be described by a proper translation into symbolic language.

Interest in the physical sciences also suffers a great deal because their relations to the neighboring sciences, such as biology, astronomy, and geology is not enough emphasized, either on the high school or at the

college level. As a consequence, the students entering college are prejudiced against the physical sciences and, as has been pointed out, the duty of the scientist himself is to see to it that the importance of the physical sciences as the basis for medicine, biology, and agriculture, as well as the basis for engineering development, is stressed in such a way that practical applications become evident.

But physics is also natural philosophy, and this philosophical aspect, the development of ideas and concepts through science, has to be emphasized not only for the non-scientist but just as well for the scientist. If we want to avoid the training of only scientific technicians, the broad aspects of the sciences and their interrelations are of particular importance.

The tremendous responsibility of the biologists becomes clear, because for the great majority of our school population, a course in biology is the only contact with science. Therefore, "the tactics and strategy of science," to use Conant's phraseology, must be brought to the attention of the large number of students in the biological sciences.

The social implications of the biological sciences have been stressed by pointing out the necessity of understanding that one of the most important bio-chemical reactions known in nature, is the action of light on plants or photosynthesis, which is the basis of our energy sources. The understanding of human physiology, genetics and sex education are all responsibilities of the biologists. It is shocking to learn that not all of our schools teach evolution, that only some of the teachers have a sound knowledge of the subject and are prepared to teach it.

WE MUST ACT AT ONCE to alleviate the present crisis in science teaching. In view of all the facts which we have gathered, the Committee made recommendations to increase the effectiveness of science teaching, as follows:

(1) Steps must be taken to provide improved working conditions in a high percentage of our school systems; otherwise, it will be impossible to attract and keep an adequate number of science teachers at all levels of science instruction.

It is necessary that every effort be made by the communities, the states, and the Federal Government to adjust teachers' salaries to present economic conditions. Legislation relating to financial support of vocational and technical education must be amended and future legislation be formulated to include provisions for the teaching of the basic sciences and mathematics.

(2) Every national scientific organization should make a special effort to make the public aware of the facts regarding teacher shortages.

(3) Institutions engaged in the education of teachers for elementary and secondary schools should provide stronger programs. They need to:

- a. Design a curriculum that is appropriate for such teachers.
- b. Provide training in broad areas rather than specialization in one field.

(4) Higher institutions, as well as public school systems, should provide strong in-service programs for teachers. It is as badly needed in the typical college and university as in the senior high school.

(5) Local, state, and Federal full subsistence *scholarships* should be established for students with a high degree of scientific talent as a substantial step toward a general program to encourage able youth in *all fields* to become educated to the limits of their ability.

(6) We must establish an adequate number of post-doctoral fellowships to supplement fellowship grants by universities and other organizations. This will provide:

- a. A way to utilize the ability of young scientists who have just finished the Ph.D and are eager to continue with basic research problems.
- b. Older scientists, who frequently have too many routine duties in their regular jobs, the opportunity to refresh their scientific spirit, and to study new methods of science education and research in new environments.

*Long Range Program.* Comprehensive investigations should be undertaken to:

1. determine the concepts and principles of science and mathematics essential to an adequate program of general education.
2. secure experimental data to aid teachers in planning an effective grade and age placement for the teaching of these concepts.
3. study the methods of early identifica-

tion and guidance of science talent at all school levels.

These recommendations are not very radical, nor is it particularly expensive to carry them out. They are the bare minimum to assure that we will have enough well-trained teachers for our schools and be able to train an adequate number of scientists for our country.

## A Letter to the Readers

At the beginning of the new year and of a new volume of *The American Biology Teacher* a letter from the editor to the readers is perhaps in order. As the older members realize, your editor is not a great believer in the importance or efficacy of editorializing; there always seems to be a large amount of material to be printed and most of it seems more important than do editorials. But once in a while, particularly at the beginning of a new membership year, a statement from the editor may have some value.

The thesis for this editorial is the trite old statement that the magazine belongs to the readers. The editor includes what he thinks most of the readers want and leaves out what he thinks most of them do not want. His guess as to what the readers want and do not want is not always reliable. His readers do not report to the editor very often. But he does get some letters of comment, approval, disapproval, question, explanation, and the like. From time to time he sends questionnaires to the associate editors, eliciting their opinions on reader interest. At meetings there are opportunities for gathering information on the phases of the journal that are of most, and of least, interest. And there is a constant stream of manuscripts coming in; these are probably written for the most part in the fields of greatest interest to the authors.

From the standpoint of letters of comment, it seems that the most popular features of our journal are the short illustrated articles that deal with some laboratory demonstration or teaching aid, the reviews and briefs, and the short items such as were published in the BY THE WAY column, which has recently been replaced by BIOLOGY LABORATORIES. The responses to questionnaires indicate about the same choices. But when questions are asked at meetings and when individuals are questioned in person, there are more frequent votes for long articles and for articles of a philosophic or integrative nature.

As might be expected, there is every extreme of opinion among the readers of such a journal as ours. In the years that I have been editor I have frequently been criticized for being too strict on editorial policy and making the journal too technical, and about the same number of times for being too lax and not maintaining a sufficient degree of professional dignity in the journal. I have received letters dealing roughly with the "philosophical stuff" and other letters asking for more of the same. One pair of letters of special interest arrived within a few days of each other; one from Connecticut and one from California. The former said the journal appealed only to western readers and was

of little use to eastern teachers and the latter said that the magazine might be of value to easterners but it certainly did not advocate the type of biology taught in the west. Yet when I asked both what improvements they would make, it was difficult to find any differences in their recommendations. I have since received letters from both individuals commending the journal for its improvement — does this reflect any change in the journal? To my knowledge, neither the policies nor the general procedures have been changed since 1942.

It is the hope of all editors that each issue of the magazine will include some items of interest to any reader who may chance to delve into it, and of course I am no exception. I am sure that a large number of readers are interested in short, to-the-point, teaching aids, in illustrations, in specific items of information on teaching procedures, in reviews and briefs from biological literature, and in practical "items." So this is an invitation to send items of that sort in great profusion. But many readers have special interests and *The American Biology Teacher* also wants contributions from them, articles on the philosophy of biology, the objectives of biology teaching, the betterment of instruction, the principles to be included for courses in general and college preparatory biology, biology at the elementary level, and so on. We want an occasional article that the reader can "set his teeth in" and he may have to study several times to understand fully. So do not hesitate to send in your articles just because you think they may not fit in. Anything that is related to the teaching biology fits in to the expressed purpose and the official philosophy of *The American Biology Teacher*.

A magazine such as ours is better if

it has more readers than if it has fewer, so this is also an invitation to all readers to invite some one else to become a subscriber. Nearly every issue of the journal has a membership blank in it; the secretary will be happy to receive your application for membership whether it is on a blank or not, however.

And finally, such a magazine as ours depends to a large extent on the cooperation of the advertisers; so every biology teacher interested in the betterment of the journal can contribute to it by patronizing the firms who advertise in it and by mentioning the journal when answering advertising.

With best wishes for a happy and successful 1949 and with a cordial invitation to send in anything you have in mind, I am

Sincerely yours,

JOHN BREUKELMAN

## NEW OFFICERS

The results of the election of officers of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS for 1948 have been received from the secretary-treasurer. The elected officers, who have assumed their duties as of January 1, 1948, are as follows:

*President:* Ruth A. Dodge, Johnstown High School, Johnstown, New York.

*President-elect:* Betty Lockwood, Harvard School of Public Health, Boston, Massachusetts.

*First Vice-President:* Richard L. Weaver, North Carolina Resource-Use Education Commission.

*Second Vice-President:* Dorothy C. Miller, State Teachers College, Cedar Falls, Iowa.

*Secretary-Treasurer:* John P. Harrold, Midland High School, Midland, Michigan.

The new president needs no introduction to readers of *The American Biology Teacher*. She has been an active member of the association and a contributor to the journal from the very beginning. Among her specific contributions have been active service on the editorial board and membership on

many important special and standing committees. She has attended most of the national meeting of the NABT and has made important contributions to their success. She is well known throughout her section of the country as an enthusiastic teacher and a progressive leader in activities for the betterment of teaching. The association is fortunate to have as its leader for 1949 one who is so well versed in teaching itself and in the betterment of teaching and teaching conditions.

Biographical sketches of the other officers appeared in the October issue. All of them have been active members of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS, having served on many different committees and performed many special duties. All of them are leaders in science education in their respective areas. All of them has broad interests and experiences that enable them to see the larger problems of science education as well as the immediate problems of the classroom. The editorial staff extends on behalf of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS and *The American Biology Teacher* sincere congratulations and best wishes for a happy and constructive year.

REQUESTS FOR THE TEN-YEAR cumulative index were not sufficient to justify its publication as a separate unit; however, several readers did write expressing the hope that some sort of index would be compiled. It is probable that a condensed index, including only the major articles, special issues and other special features, will be published in one of the regular issues in the relatively near future.

THE FINAL PAGE PROOF for this issue had to be sent to the printer before reports of the annual meeting could be formulated and sent to the editor. These will appear in the February issue. As in previous years, *The American Biology Teacher* will attempt to bring to its readers as much as possible of the meeting. Some of the papers will be published in full and others will be summarized and abstracted. Demonstrations and field trips cannot be transmitted by the

medium of the magazine, but even these will be reported. The March issue will be devoted largely to the report of the annual meeting. Last year, the February issue was the national meeting issue, but this occasioned a considerable delay in publication.

## LOW TEMPERATURE BIOLOGY

Scientists are unravelling mysteries of chemical substances important to biological processes by studying them at extremely low temperatures which slow down molecular motion.

By reducing chemical compounds to temperature near absolute zero, details of complex molecules hitherto unobservable can be studied by spectroscopic methods, he said. The research throws new light on cell division and growth and also on substances affecting living organisms, he said, and it therefore leads to a better understanding of the processes that take place in living systems, both in normal functioning and disease.

"The solution of many of the fundamental problems of biology and medicine depends on finding out the exact nature of the chemical substances involved in biological processes. Thus, the isolation and identification of various vitamins and hormones has led to great advances in nutrition and the control of disease. Many chemical compounds of interest in biology and medicine are exceedingly complex. Optical methods, especially such techniques as absorption spectroscopy, are often of great use in the investigation of their structure. The usual methods of ultraviolet and visible absorption spectroscopy do not, however, yield as detailed information as desired for exact studies of many biochemically important substances.

"At room temperatures, various physical factors arising from the heat motion of molecules would be expected to result in loss of detail in the information obtainable by absorption spectra. This circumstance suggested the possibility of obtaining more detailed information about chemical molecules by applying spectroscopic methods at low temperatures.

"The increased spectral detail thus obtained at low temperatures is of use not only in unravelling mysteries of structure in biochemically important substances but also in identifying such substances when they are intermixed with other compounds of similar structure."

The research was conducted jointly by John R. Loofbourow, R. L. Sinsheimer, and J. E. Scott, all of Massachusetts Institute of Technology.

### AUDUBON FIELD NOTES

The publication of *Audubon Field Notes* is now one of the largest co-operative undertakings in bird study. Since the July 1947 issue, this periodical has been produced through the collaboration of two of the largest conservation organizations—the National Audubon Society and the U. S. Fish and Wildlife Service. The National Audubon Society, which launched *Audubon Field Notes* as a magazine independent of its parent journal *Audubon Magazine* with the January 1947 issue, has continued to give it the necessary financial backing and to supply assistance in the production of the magazine through the service of one of its staff members as an associate editor. The Fish and Wildlife Service contributes the services of three of its ornithologists, who act as editor and associate editors, and makes available its resources of bird records (from maps and files) and coordinates its own distribution and migration observers cooperative program with that of *Audubon Field Notes*.

An important element in this cooperative enterprise is the group of 14 Season Editors, who are literally regional representatives of *Audubon Field Notes*, organizing the information and writing up reports based on the notes of the observers. The Season Editors are really the key to the success of the section "The Changing Seasons."

The real basis of this cooperative program is, of course, the interest and effort of the individual observers who supply the records, whether they be for the Season reports, Christmas Counts, Breeding Bird Censuses, or Winter Bird Population Studies and with-

out which there could be no *Audubon Field Notes*. On the quality of the records of the field observers, whether obtained by individuals working alone, or by organized groups or bird clubs, rests the value of the contribution made by *Audubon Field Notes* to the knowledge and understanding of the birdlife of North America. We do not have a very definite estimate of the total number of bird observers who are actually contributing to *Audubon Field Notes* at the present time because many of them contribute through their organizations. However, if the number were known, it probably would be surprisingly large. We are, at present, trying to obtain through our Season Editors the names and addresses of all contributors. It would be appreciated if all contributing clubs would make available to us names and addresses of their members who are participating. Potentially the number of contributors is as large as the total number of persons engaging in field observations of American birds.

A relatively new practice to obtain more complete information on the distribution of North American birds has been to publish in *Audubon Field Notes* the distribution maps from the files of the Fish and Wildlife Service. Readers are urged to help make these maps more nearly complete by supplying records to fill apparent gaps in distribution or to rectify incorrect relative abundance status indicated on the maps. Eventually many of these maps will be republished showing these corrections.

An additional approach of obtaining information on relative abundance simultaneously at a number of points throughout the country is the "Christmas Bird Count" which has become an institution to American bird-students.

One of the most important types of bird study is that in which an attempt is made to obtain more exact figures on actual abundance of birds at times of the year when they are relatively sedentary and therefore more easily accounted for. Such studies are being encouraged through the "Breeding Bird Census" and "Winter Bird Population Study" sections, each of which occupies one issue

a year. Exact information about numbers of birds per unit of habitat is vitally important in determining what types of habitat produce the largest numbers and greatest variety of birds so that we can appraise the effects of various land uses such as agriculture, forestry, and industry on birds by the way they modify habitats. Bird students who have become proficient in the basic methods of identification and recording of species are urged to extend their activities to include breeding and winter bird censusing. It may seem more confining but the results are likely to be of great value.

It may be stated then that the basic objective of *Audubon Field Notes* is to give as many as possible of the individual bird-watchers of America—whether they be professional bird-students or seriously interested amateurs—a chance to cooperate in presenting just as accurate a picture as possible of the current conditions of birdlife in their respective regions, so that they may know that they are contributing toward a knowledge of these conditions and the reasons for them, both as an interesting permanent record and also as an aid to conservation agencies in keeping track of changing trends in abundance of birds.

From an editorial in *Audubon Field Notes*, Sept. 1948, by John W. Aldrich.

## Biological Briefs

DOCK, GEORGE, JR., What Glasses for Birds? *Audubon Magazine*, Vol. 50, No. 5, p. 316, Sept.-Oct. 1948.

The experts use glasses of many powers and specifications, so what is the amateur to choose? No single glass meets all the desirable requirements in equal degree. In a recent survey the 7×35 glass appeared to be the first choice of the largest number of persons asked. The magnification of seven diameters is large enough to bring most details into view at reasonable distances and small enough to permit one to hold the glass steady without placing it on a support of some kind.

A seven-power glass has a field about 150 yards wide at a distance of about 1000 yards. The 35-millimeter lens admits enough light to give a bright image under most conditions. It is important to note that the second number in the designation of a glass does not have anything to do with the field size. It indicates the diameter of the objective or front lens, and is therefore a measure of the amount of light admitted, or of the relative brightness of the image.

CHERBONNIER, MARIE ELINA, Critical Thinking in the Use of Alcohol and Tobacco, *The Science Teacher*, Vol. 15, No. 3, p. 114, Oct. 1948.

The adolescent is conditioned against preaching. He must be convinced that he is dealing with reliable formation, or at least with information that seems reliable to him. He can be taught to study the "credentials" of an author and to distinguish between sweeping statements based on emotion and carefully considered judgements based on experiments and records. In the study reported the students made their own surveys, with no opinions from the teacher. Comparison between the pre-test and the questionnaire given at the end of the study shows evidence of much critical thinking on the part of the students, resulting in many changes of opinion and in the development of constructive attitudes. The teacher felt that the students had made some progress in looking for reliable authority, in discrimination between assumptions and facts, in withholding judgements and in recognizing the place of the scientific method in the solution of social problems as well as in biological laboratory problems.

HADLEY, C. H., Control of the Japanese Beetle, *Plants and Gardens*, Vol. 4, No. 3, p. 188, Autumn 1948.

Japanese beetle grubs are subject to several diseases caused by microbes. Among these are the "milky diseases" the bacteria of which are ingested (in spore form) by the grubs, eventually resulting in the weakening and death of the grubs. The United

States Bureau of Entomology has developed a device for inoculating living grubs with the bacteria and using the infected grubs for mass production of the spores. The "spore-dust" is applied to beetle-infested soil. When the bacteria become established in the soil the beetle population goes down rapidly. One application of spore-dust is usually enough to get the bacteria started. Where quick results are essential DDT or lead arsenate must be used for the first season or two. The effectiveness of milky disease builds up over several seasons. The disease does not directly affect adult beetles, but of course reduces their numbers by killing the grubs. Since the beetle is a good flier, there is of course constant danger of reinfestation of a soil area that was previously freed from beetles.

**The Mechanical Properties of Human Bones**—A Technical Report from the National Bureau of Standards, Washington, D. C., *The Science Counselor*, Vol. 9, No. 3, p. 98, Sept. 1948.

How much physical shock can the body stand? How much compression can human bones undergo before shattering? Are our bones as strong as steel? As hickory wood? Work by the National Bureau of Standards indicates that ordinary techniques and instruments can be used to find the answers to these and other similar questions. Why is it important to find answers to them? High speed aviation has created many problems concerning safety devices. Sometimes an airplane is completely wrecked and the occupant gets by with hardly more than a bruise; at other times a relatively slight blow on some part of the body causes serious or even fatal damage.

Preliminary data indicate that bone may be considered an elastic, brittle material having about one fourth the compressive strength of cast iron and about twice that of hickory. The elasticity is about that of wood.

PATRONIZE *American Biology Teacher* advertisers and mention the magazine by name whenever you write them about any of their products.

## Reviews

### BOOKS

GOETHE, C. M. *Geogardening*. The Keystone Press, Sacramento, California. xx + 350 pp. 1948.

C. M. Goethe needs no introduction to the reading public. He is remembered as the author of *Sierran Cabin From Skyscraper*, *War Profits and Better Babies*, and numerous other writings. His friends will welcome this new contribution and its influence toward reducing "biological illiteracy" in the United States. This book is an account of the author's ransacking the world in quest of first-hand information about the flowers, shrubs, and trees in his garden, with the view to ascertaining their genesis and ecological relationships, both biological and physical, between the plants and their 'Sauvage' environments. The reader is taken from one geogardening experience to another, as the author engagingly describes his wanderlusting to Japan, China, France, Mexico, Africa, Tibet, South America, and, in addition, many other countries. Each of the ninety one brief chapters is devoted to a separate theme. Gardenlovers will find comments upon their favorite flowers, shrubs, and trees. A limited number of those discussed will be mentioned. They are: Acacia, Almond, Begonia, Birch, Cactus, Canna, Pine, Cosmos, Ivy, Date palm, Elm, Fig, Iris, Maple, Pansy, Tulip, and Wistaria. This discriminating traveler and writer enhances the reading enjoyment with frequent statements about places, people, animals, local philosophies, and folk lore.

Concomitant, throughout this work, is the author's plea for an improvement of Human Genetics. This advocacy, from one who so conspicuously exemplifies his own teaching, may well be scrutinized and extended by every biology instructor from the secondary school through the university. Typical of the many references to Genetics and Eugenics are the following: "It has lifted man from the stooping, bent-kneed Neanderthals to the Aristotles, the Shakespeares, the

Pasteurs, the Edisons." Also, "Intelligent plant and animal breeders, utilizing its laws, have through long-continued Artificial Selection built up valuable strains, horses and hens, plums, peonies and potatoes." Again, "One important result of applied eugenics will be the reversal of the present dysgenic trend of the birthrate of The Talented. We need, for example, more of the researcher pattern of intelligence."

*Geogardening* is illustrated with over two hundred black and white photographs. They cover a wide range of subjects, including plants, animals, people, places, and things. This feature alone makes the book one of interest and value. Also, numerous quotations from poems are included. This book was not placed on sale. Copies of it, however, may be obtained in practically all state, city, and college libraries in the Nation.

LEE R. YOTHERS,  
*Rahway High School,  
Rahway, New Jersey*

WEATHERWAX, PAUL. *Plant Biology*. Second ed. W. B. Saunders Co., Philadelphia. 451 pp. 1947. \$4.00.

Mr. Weatherwax, professor of Botany at Indiana University, brings his second edition up-to-date with the addition of the antibiotics, penicillin and streptomycin to his revised discussion of bacteria. Late information on enzymes and vitamins have also been included. Other additions are more detailed discussions of auxins and their relations to tropisms and flowering, and a fuller treatment of plant responses to stimuli. For the readers not acquainted with the first edition, this book was designed for college freshman and sophomores, not previously acquainted with the field. The selection and arrangement of topics using a pedagogic approach prove easy reading to one new to the field. This is a concise treatment of the bare essentials of botany.

The 26 short chapters are each ended with a half page of summary—no questions or references commonly found in a more detailed treatment. Topics appear in capitals in the center of the page with subtopics in smaller capitals on the left. Diagrammatic

drawings are conveniently placed, and not too numerous. Clear photographs are well spaced, informative, and contain only the subject under study. Key words are italicized and most of them appear in the 23 pages of the self-pronouncing glossary. This regularly-sized, well-bound book is ended with an uncrowded and workable 21 page index. *Plant Biology* should make an excellent textbook for a quick treatment of plants on a non-professional basis. Supplemental material would be needed for a more detailed study.

IVAN J. SHIELDS,  
*University of Kansas,  
Lawrence, Kansas*

## ANATOMICAL CHARTS

Charts recently received for review include one, published by Rudolf Schick, 700 Riverside Drive, New York 31, N. Y., of the lymphatic system. In 30×54 inch size, this chart includes life size views of the general lymphatic system; throat and mouth cavity; lymphatics of the stomach, liver and intestines; also the following magnified views: lymph node (×30), cross section of a lymph node (×40), section of small intestine (×40), skin section (×50), lymph plexus (×100), a villus (×600). In full color, the chart makes clear one of the most difficult of the systems to visualize.

The full line of Shick charts includes most of the body systems and many organs, as well as the nutritive values of foods and other physiological subjects. The charts, mounted on linen, may be obtained on top-and-bottom rollers or on spring rollers. Prices are \$6.25 and \$8.25 for the smaller sizes and \$8.00 and \$10.00 for the larger sizes.

## NEW FILMS ON DEMOCRACY

*The Nature of Democracy* a series of seven discussional slidefilms, is announced by The Jam Handy Organization. This series is produced in color by Curriculum Films Inc. The material in these films is based on extensive research and investigation. The sub-

jects are designed primarily for use in Junior and Senior High Schools, each film guiding a discussion by the class. With each series there is a booklet of suggestions for teachers using the series. Slidefilms are: 1. Democracy at Work; 2. Freedom of Religion; 3. Equality Before the Law; 4. Taking Part in the Government; 5. Freedom of Expression; 6. Education; 7. By and for the People. For details, address The Jam Handy Organization, 2821 East Grand Blvd., Detroit, Michigan.

## BIOLOGY LABORATORIES

**MR. HORVATH** of Pennsylvania, a biology teacher writes, "Located in the hard coal field regions of Pennsylvania—there is an abundance of fern fossil in the slate". Here would be an interesting project for your classes. Would you be interested in these fern fossils as a teaching aid? Would you be interested in a fern fossil display at a moderate fee for the trouble? Write your comments and we will see that they are passed along. Thanks, Mr. Horvath, for the letter.

**FERN FOSSILS.** How many of you good people have had experience with fern fossils? I remember some time ago that certain individuals from the Chicago area were going down to Coal City, not too far away, searching for these fossils. I spent the better part of a day there myself many years ago. These are strip mines.

**CONSERVATION.** *The Natural History Survey* spent considerable time at the strip mine areas. They were interested in reclamation and reforestation of these waste lands. They even were interested in creating artificial lakes there. Lack of funds hampered their efforts.

**HAS ANY ONE HAD EXPERIENCE** in incubating chick eggs for embryos? Bought a few fertile eggs and started them the other day. My results were not so good. I used a small sized incubator. The thermostat maintained the proper hatching range and the eggs were turned. Should there be a lapse of time be-

tween the laying time and the start of incubation? What temperature should the eggs be stored at during this time? Some of you chicken farmer biologists give us the information.

**LIVER FLUKES.** A few days after Thanksgiving we received a package from the northwoods area. It contained a small olive bottle filled with alcohol and several liver flukes. Mr. Falk, the sender, a graduate of Michigan State in conservation, removed them from a deer. He states this infection is very common in this area. Does any one know the name of the particular fluke that inhabits such livers in this area?

**LOWER CASE "b".** Having taught for a quarter of a century I thought it about time to learn whether "biology" is capitalized or not. The word "biology" is not capitalized nor are the words "biology teacher." However in titles, names of associations and magazines, the words are capitalized. Examples of these are *The National Association of Biology Teachers* and *The American Biology Teacher*. I am not so smart; I asked one of my students and he told me. He then gave me proof from an English text.

**CLEAN UP** that dip net used two months ago, still on the big aquarium where it was left. The jug containing formaldehyde is still on the front desk after some earthworm preserving last fall, and on the rear bench is a hammer, saw and several nails left there by folks repairing a seed-flat weeks ago. It is time to clean house in the laboratory. Enlist the students to help you with the work.

**OLD MANUALS AND PAMPHLETS** often contain much that could be of use. These can be cut up and filed under proper headings. I had the pleasure of sharing a biology laboratory several years ago with a teacher who had followed this practice. Her pupils were greatly enriched with bulletin board information and had access to the material for outside work.

**TEXT SELECTION.** If you are contemplating a change of text or a manual for your course, contact the various publishers for sample

copies. They furnish these without cost. With a wide selection to choose from you will find your job easier. You will always find there are two or three that serve your purpose best.

**HAVE YOU GIVEN YOUR PLANTS a feeding recently?** Early spring is the time to give them a boost. During the darker winter months they should be left much to themselves. This pre-season stimulus can be any one of the commercial or natural fertilizers. A teaspoon full of fertilizer of the commercial variety to a four inch pot is sufficient. Give them another feeding in about four weeks. When applying keep it away from leaves and stems. Wash down with extra water.

**COMMERCIAL FERTILIZERS.** Ordinary commercial fertilizers contain nitrogen, phosphorous and potash. The percentage of each is given on the bag. Generally the total percentages of these three elements equals twenty per cent of the material. The remaining eighty per cent is filler or inert material.

**EARLY MARCH** is not too soon to start seeds of the slow growing plants. These slow growers include petunias, peppers, ageratum, alyssum, snapdragons, salvia and others. Seeds of the lupine must be cracked for best results. Four to six weeks later you may sow the faster growing seeds which include marigold, tomatoes, zinnias and others.

**DO YOU KEEP A DIARY?** During various years from 1933 to 1941 I kept records of biological facts and greenhouse activities. The record data of the preceding fast and slow growers was just obtained from these books. Any book will do but spend a few added cents and get a durable one.

**FOUR WATT.** I am searching for a four watt fluorescent lamp to use at the substage of the microscope. They make them. Have you had experience with these?

Send in your suggestions to BIOLOGY LABORATORIES, 5061 N. St. Louis Avenue, Chicago 25, Illinois.

**FIRST AID:** First aid information is a must for every laboratory teacher. The minimum instruction would be for the treatment of cuts, burns, and location of first aid supplies. Students also should have instructions for contacting a physician and the hospital. This information should be posted in some conspicuous part of the room along with the fire drill signals.

**IDENTIFICATION:** You would not attempt to teach about a plant or an animal without identification. It could be done but it would consume a large amount of time. The same things holds for identification of materials in the laboratory. Every drawer, cupboard or container should be labeled as to what it

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contains. It will save you time and in case of your illness aid the substitute in efforts to carry on for a day where you left off.

**GOOD ILLUMINATION** is a must for laboratories today. If there are changes to be made be sure you include a good source of light for the microscopes. Provide comfortable convenient benches and stools for the use of the microscopes at the windows. In case you are unable to do this, substitute illumination should be provided for each microscope. These are obtainable in catalogues of science supplies.

**MICROSCOPIC MATERIALS:** It is fine to bring in fresh microscopic materials for study. Water seems to be an important adjunct for maintaining freshness. In making your own slides have sufficient slides and cover slips on hand. You should have at least one dissecting set that you keep in your own desk for your personal use only.

**KEEP A WANT LIST** in your supply room. This can be a simple not book or a blank

piece of paper. Have a particular place for this and keep it there, to use when ordering supplies. Jot down needed items at the time shortages are noted.

**A DESIRABLE SUPPLY TABLE** on wheels is a fine adjunct to any laboratory. It should be sufficiently narrow to pass thru doors and aisles. The table could be made by shop minded boys. Wheels for it can be purchased at a hardware store. Get them big enough to pass over small obstructions. The table can be used to transport projection equipment, or materials from the supply room to the laboratory. It serves as a fine projection stand. Rubber tired wheels well oiled save nerves on the afternoon of a hard day of work.

**DATE SUPPLIES:** Supplies when received are dated on the label with a wax pencil. Previous stock purchased is used first. The new stock is placed behind the old stock so that the old may be used first. You played grocery store when you were a kid; put those practices into effect with supplies.

## Microscope Slides of Starfish Embryology

• New stocks of microscope slides of all stages of the embryology of *Asterias forbesii*, the Atlantic starfish, have been prepared. The following are now available for prompt shipment:

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E4.12 <i>Asterias</i> , ovary. Sections show ma-	..... .60
turity and developing eggs	E4.42 <i>Asterias</i> , gastrula (embolic). Stained
E4.13 <i>Asterias</i> , mature eggs, w.m.	to show the individual cells, w.m.
..... .50	..... .60
E4.21 <i>Asterias</i> , polar body formation (mat-	E4.45 <i>Asterias</i> , late gastrula, mesoderm for-
uration complete before entrance of sper-	mation, w.m.
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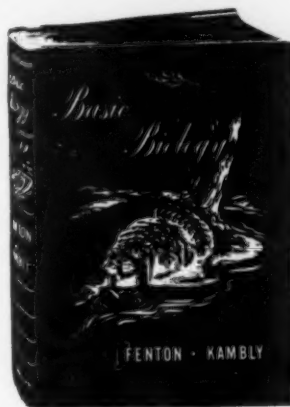
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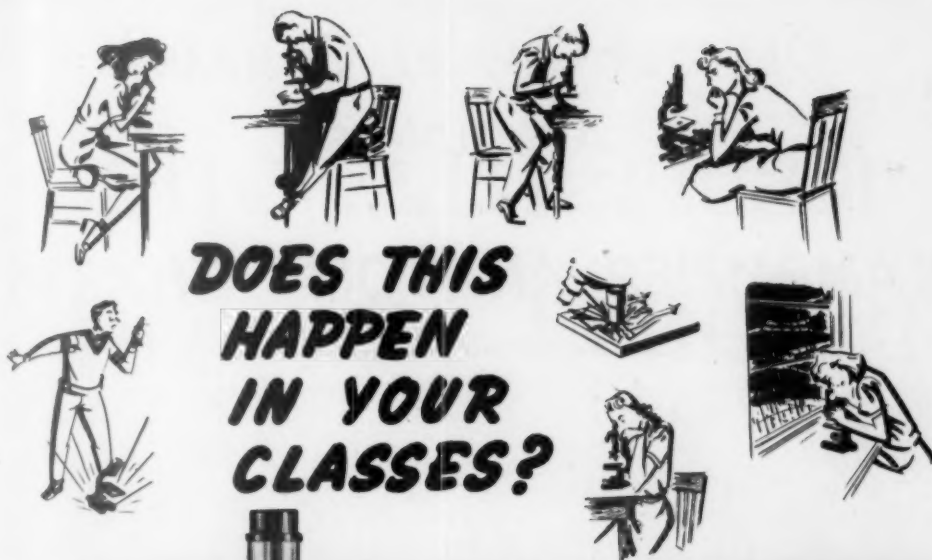
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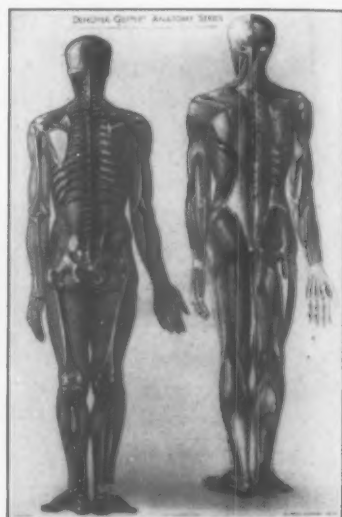


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